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Kidney Complications in Children with Bronchopulmonary Dysplasia

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Abstract

Objective: To describe kidney outcomes in a cohort of children with bronchopulmonary dysplasia (BPD).

Methods: We assessed short-term (acute kidney injury defined using neonatal KDIGO criteria) and long-term kidney outcomes, including chronic kidney disease (defined as a GFR <90ml/min/1.73m^2), albuminuria, and hypertension in a single-center retrospective cohort of children with BPD born between 2010–2020.

Results: 309 (38.8%) of 797 children included in the cohort had acute kidney injury (AKI) during their NICU admission. Kidney specific follow-up evaluation was infrequent in this cohort;

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Consent Statement: The Institutional Review Board at the Indiana University of Medicine approved this study. A waiver of informed consent was obtained for this study (IRB # 1710518896).

52.4% of patients had serum creatinine testing and 31.5% had a urinalysis performed after discharge. 163 (32.0%) of 510 patients with long-term data had CKD, which occurred at a median age of 2.2 years. An abnormal eGFR occurred in 31.7%, proteinuria in 12.5% and hypertension in 15.2%.

Conclusions: Children with BPD had high frequencies of AKI and CKD. While the retrospective nature and single-center convenience cohort design limit generalizability, our findings suggest that children with BPD should be carefully monitored for short- and long-term kidney outcomes, including CKD.

Introduction

Bronchopulmonary dysplasia (BPD) is a chronic lung disease diagnosed in 16,000 children each year in the United States.[1] BPD occurs in more than half of children extremely premature (<28 weeks gestational age) and contributes to high medical costs and a lifelong risk of impaired pulmonary function.[2] Despite improved survival, short- and long-term morbidity remains high, and children with BPD account for massive resource utilization during their lifetime.[2]

Recent evidence suggests that kidneys and lungs are closely related as they develop along a similar timeline and play similar roles in maintaining volume status, acid-base balance, and blood oxygenation.[3] We and others have previously reported that infants with acute kidney injury (AKI) have a higher likelihood of BPD.[4–6] Recent studies show that prematurely born children with an episode of neonatal AKI have a two-fold increase in chronic kidney disease (CKD).[7–9] Little is known about the long-term kidney health of prematurely born children with BPD. To begin to address this gap, we evaluated kidney-related outcomes in a single center retrospective cohort of children diagnosed with BPD.

Materials and Methods

Study design

The Riley Children's Hospital BPD Database includes patients with a diagnosis of BPD hospitalized in the Neonatal Intensive Care Unit (NICU) at Riley Hospital for Children (Indianapolis, IN) between 2010 and 2020. Patients are included in the BPD Database if (1) born <32 weeks gestational age, (2) alive at twenty-eight days and (3) diagnosed with BPD during their NICU admission. The BPD registry used Jobe criteria defined as those receiving respiratory support at 28 days of age.[10] These definitions were selected based on the time of registry development (2010) and the goal of understanding clinical trends at a single center over time.

For this secondary study, kidney-specific data for each previously identified patient were retrospectively collected from the electronic health record by a member of the study team. Additional data included demographic and birth information, kidney outcomes in the NICU, and kidney outcomes after discharge from the NICU as available as part of their care. A waiver of informed consent was obtained for this study, and this study was approved by the Indiana University Institutional Review Board (IRB #1710518896).

Kidney Outcome Definitions

We determined AKI using standardized neonatal Kidney Diseases Improving Global Outcomes (KDIGO) definitions, including both serum creatinine and urine output criteria.[11] Using serum creatinine criteria, Stage 1 AKI was defined as a 1.5–1.9x increase or an increase of 0.3 mg/dL from baseline within 48 hours, Stage 2 as a 2.0–2.9x increase, and Stage 3 as a >3x baseline or serum creatinine >2.5mg/dL. Per urine output criteria, Stage 1 AKI was urine output of <0.5 mL/kg/h over 6–12 hours, Stage 2 as urine output of <0.5 mL/kg/h for 12 hours or longer, and Stage 3 as urine output of <0.3 mL/kg/h for more than 24 hours or anuria for more than 12 hours. For AKI determination, we used a baseline of the lowest creatinine at any point prior to the diagnosis of AKI after postnatal day 2.[12] Individual peak creatinine measurements had to be ≥0.5 mg/dL to be considered in the AKI calculation. As creatinine levels on postnatal days 0–2 may represent maternal levels, we began AKI calculation on postnatal day three.[13] We did not collect data on recurrent episodes of AKI, and only considered the highest degree of AKI during hospitalization. We defined persistently elevated serum creatinine as creatinine at or above 0.5 mg/dL at two weeks of life.[14] Patients with less than two serum creatinine values were excluded from AKI analysis.

We considered a subject to have sufficient data to determine long-term outcomes if they were followed in our health system until at least two years of age and had at least one of the following recorded: (1) serum creatinine, (2) urinalysis or (3) blood pressure measurement. Long-term kidney outcomes included chronic kidney disease defined by a decreased glomerular filtration rate (eGFR), albuminuria, and elevated blood pressures.[15] eGFR was calculated using serum creatinine and the bedside Schwartz equation.[16] Albuminuria was defined as an albumin/creatinine ratio (ACR) >30 mg albumin/g creatinine. Elevated blood pressure was defined as having three or more clinical values exceeding the 90th percentiles for age and sex-related norms or a diagnosis of hypertension in the electronic medical record.[17] As these kidney specific long-term outcomes were only recorded when clinically obtained, they were only available in a percentage of the cohort.

Statistical analysis

Categorical variables were summarized with frequencies and percentages and continuous variables were summarized with median and interquartile ranges. Categorical variables were compared with Pearson’s chi-squared tests. Continuous variables were compared using Kruskal-Wallis tests. REDCap (Research Electronic Data Capture) was used for study data collection and management.[18] In all analyses, a p-value <0.05 was considered statistically significant. Statistical analyses were performed using Stata/SE 17.[19]

Results

Patient Characteristics

797 children were included in analyses for AKI outcomes of the 1,002 enrolled in the BPD database at Riley Hospital for Children from 2010–2020 (Supplemental Figure 1). Of these 797 children, 52.7% were male, the mean gestational age was 26 weeks (SD 2.2), and the mean birthweight was 951 grams (SD 355).

Short-Term Kidney Outcomes

Neonatal AKI occurred in 309 (38.8%) of children with BPD (Table 1). Of those with AKI, most were diagnosed by serum creatinine criteria alone (64.4%) and 107 (34.6%) had severe (Stage 2 or 3) AKI. Only half of children with an episode of neonatal AKI had a diagnosis of AKI documented on their discharge summary. Persistently elevated serum creatinine (≥0.5mg/dL) at two weeks of life was common among children with BPD in our cohort, occurring in 70.0%. Those with AKI had higher rates of persistently elevated serum creatinine (89% vs. 63%, $p<0.001$) compared to children without AKI. Children with AKI were more likely to have nephrology consultation during their admission (38% vs. 14%, $p<0.001$) compared to children without AKI (Figure 1).

Long-Term Kidney Outcomes

Follow-up of children with BPD after NICU discharge was inconsistent. Of the children enrolled in the BPD cohort (N=1,002), less than one-quarter had scheduled follow-up appointments with either nephrology (12.1%) or urology (18.1%). For children who had a follow-up visit with nephrology, the most common reason for follow-up was acute kidney injury (72.5%) followed by hypertension (21.7%). For those that had follow-up appointments with urology, the most common reason was hydronephrosis (78.9%) followed by urinary tract infection (11.1%) (Table 2).

Only half had at least one serum creatinine value obtained after hospital discharge (52.4%) and one third had a urinalysis performed (31.5%) after NICU discharge. A majority had blood pressure measurements after NICU discharge (77.4%). Therefore, long-term kidney outcome status was able to be determined in 510 patients (Table 2).

Among those available long-term data, 32.0% had CKD based on an estimated GFR <90ml/min/1.73m^2. For those with CKD, the median age of diagnosis was 2.2 years of age. Proteinuria was observed in 12.5% of patients at a mean age of 4.7 years, and hypertension was measured in 15.2% of patients at a mean age of 2.0 years (Table 2). Compared to those without CKD, those with CKD were more likely to be born small for gestational age (14.7% vs. 7.8%; $p=0.015$) and more likely to be born as part of a multiple birth (23.9% vs. 15.3%; $p=0.014$; Table 3).

Discussion

This retrospective study describes the incidence of kidney complications in a single center cohort of children with BPD. While we report similar rates of AKI compared to previously reported cohorts of premature infants,[12,20] almost one-third of children in our BPD cohort with at least 2 years of clinical follow-up had CKD based on a decreased GFR, a rate higher than has been previously reported in similar patient populations.[21] Our findings suggest that kidney complications may be more common in children with BPD than previously recognized.

To our knowledge, this is the first report of CKD prevalence in such a cohort, and our described rate of CKD is higher than has been recently reported in a cohort children born <28 weeks gestational age.[21] In infants, CKD is more common in those with a single severe episode of AKI, repeated AKI episodes[22], and other factors such as low birth weight and small for gestational age status. All of these factors may contribute to decreased nephron number or may increase the risk of kidney injury.[23] Infants in this study were more likely to develop CKD if they were born small for gestational age or part of a multiple birth. We did not see an association between gestational age and CKD development in this cohort, though the incidence of CKD was higher among children born at a lower gestational age. This finding could suggest that other factors hold greater importance in determining if a child will develop CKD and suggest that children with BPD should be carefully monitored for long-term kidney outcomes. Furthermore, we also observed a large percentage of children with either proteinuria or hypertension (13% and 15%, respectively). As proteinuria and hypertension can be the first indicators of future chronic kidney dysfunction before declines in GFR, these children may be at risk of long-term CKD during childhood or adolescence beyond the rate of CKD that we describe.

We report one-third of children in this cohort with BPD had an episode of AKI during the NICU admission, comparable with AKI frequencies of critically ill infants.[15,20] We also described a high incidence of persistently elevated serum creatinine at 2 weeks of age, which may be an early warning sign and a harbinger of future kidney dysfunction or CKD later in life.[24] This finding is also consistent with the literature that AKI is not an isolated event but may result in an increased risk of CKD. These finding merits further evaluation in a prospective manner as early risk stratification of infants at increased risk of poor kidney outcomes after discharge from the NICU would allow clinicians to identify infants with the highest risk of CKD in childhood.

This retrospective cohort study of children with BPD has several strengths, including utilizing robust, high-quality data for the detailed exploration of both short- and long-term kidney outcomes. Despite these strengths, however, there are several limitations to these findings. As this was a retrospective single-center chart review study, patients were lost to follow-up over time and had various datapoints missing, increasing the likelihood of selection bias and determination of outcomes in this cohort. We note that most missing datapoints were during initial neonatal admission were due to missing serum creatinine values, which prevented us from being able to assess AKI incidence and we did not collect data on recurrent AKI. Missing data after neonatal discharge likely occurred as some patients may have transferred their ongoing follow-up care to different healthcare facilities. This may have resulted in a skewed cohort as patients with more severe disease were followed long-term, which may result in a bias towards more ill patients. Furthermore, the high percentage of children who had follow-up with pediatric nephrology or urology may also represent a subsection of the cohort at higher risk of CKD and those more likely to have laboratory monitoring for kidney outcomes. We include all children with BPD (based on oxygen at 28 days) which may be less predictive of long-term lung disease. We also note that while there is not a comparator group of infants without BPD and our definitions of BPD may have different from other cohorts described in this manuscript due to the frequent revisions of BPD diagnosis over the last 15 years, other large studies such as the AWAKEN and PENUT studies provide estimated rates of AKI and CKD in children with and without BPD. We also note that over the course of this cohort, outpatient follow-up criteria for children with BPD have evolved, which also may have contributed to missing data after discharge.

In conclusion, our findings suggest kidney complications are common in children with BPD and merit careful monitoring, including ongoing measurement of blood pressure, as well as serum creatinine and urinalysis monitoring for albuminuria and elevation of serum creatinine. Further research is warranted to fully understand how BPD potentially contributes to CKD diagnosis and the identification of children at high risk for kidney complications to allow for appropriate outpatient follow-up and early detection of CKD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data Availability Statement

The dataset analyzed during the current study is not publically available as it was part of a clinical and quality improvement hospital registry. Anonymized and/or summarized data can be made available from the corresponding author on reasonable request.

References:

1. Baraldi E, Carraro S & Filippone M Bronchopulmonary Dysplasia: Definitions and Long-Term Respiratory Outcome. Early Hum Dev 85, S1–3 (2009).
2. Bancalari EH & Jobe AH The Respiratory Course of Extremely Preterm Infants: A Dilemma for Diagnosis and Terminology. J Pediatr 161, 585–588 (2012). [PubMed: 22785261]
3. Basu RK & Wheeler DS Kidney-Lung Cross-Talk and Acute Kidney Injury. Pediatr Nephrol 28, 2239–2248 (2013). [PubMed: 23334385]
4. Starr MC et al. Acute Kidney Injury and Bronchopulmonary Dysplasia in Premature Neonates Born Less Than 32 Weeks' Gestation. Am J Perinatol 37, 341–348 (2020). [PubMed: 31777046]
5. Askenazi D et al. Acute Kidney Injury Is Associated with Bronchopulmonary Dysplasia/Mortality in Premature Infants. Pediatr Nephrol 30, 1511–1518 (2015). [PubMed: 25808019]
6. Levesque BM et al. Low Urine Vascular Endothelial Growth Factor Levels Are Associated with Mechanical Ventilation, Bronchopulmonary Dysplasia and Retinopathy of Prematurity. Neonatology 104, 56–64 (2013). [PubMed: 23711562]
7. Mammen C et al. Long-Term Risk of Ckd in Children Surviving Episodes of Acute Kidney Injury in the Intensive Care Unit: A Prospective Cohort Study. Am J Kidney Dis 59, 523–530 (2012). [PubMed: 22206744]
8. Menon S, Kirkendall ES, Nguyen H & Goldstein SL Acute Kidney Injury Associated with High Nephrotoxic Medication Exposure Leads to Chronic Kidney Disease after 6 Months. J Pediatr 165, 522–527 e522 (2014). [PubMed: 24928698]
9. Selewski DT, Hyatt DM, Bennett KM & Charlton JR Is Acute Kidney Injury a Harbinger for Chronic Kidney Disease? Curr Opin Pediatr 30, 236–240 (2018). [PubMed: 29389682]

10. Jobe AH & Bancalari E Bronchopulmonary Dysplasia. Am J Respir Crit Care Med 163, 1723–1729 (2001). [PubMed: 11401896]
11. Zappitelli M et al. Developing a Neonatal Acute Kidney Injury Research Definition: A Report from the Niddk Neonatal Aki Workshop. Pediatr Res 82, 569–573 (2017). [PubMed: 28604760]
12. Askenazi DJ et al. Prevalence of Acute Kidney Injury (Aki) in Extremely Low Gestational Age Neonates (Elgan). Pediatr Nephrol 35, 1737–1748 (2020). [PubMed: 32488672]
13. Askenazi DJ et al. Prevalence of Acute Kidney Injury (Aki) in Extremely Low Gestational Age Neonates (Elgan). Pediatr Nephrol 35, 1737–1748 (2020). [PubMed: 32488672]
14. Gupta C, Massaro AN & Ray PE A New Approach to Define Acute Kidney Injury in Term Newborns with Hypoxic Ischemic Encephalopathy. Pediatr Nephrol 31, 1167–1178 (2016). [PubMed: 26857710]
15. Askenazi DJ et al. The Impact of Erythropoietin on Short- and Long-Term Kidney-Related Outcomes in Neonates of Extremely Low Gestational Age. Results of a Multicenter, Double-Blind, Placebo-Controlled Randomized Clinical Trial. J Pediatr (2021).
16. Schwartz GJ et al. New Equations to Estimate Gfr in Children with Ckd. J Am Soc Nephrol 20, 629–637 (2009). [PubMed: 19158356]
17. Flynn JT et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. Pediatrics 140 (2017).
18. Harris PA et al. The Redcap Consortium: Building an International Community of Software Partners. Journal of Biomedical Informatics (2019).
19. Stata/Se 17 (2021).
20. Jetton JG et al. Incidence and Outcomes of Neonatal Acute Kidney Injury (Awaken): A Multicentre, Multinational, Observational Cohort Study. Lancet Child Adolesc Health 1, 184–194 (2017). [PubMed: 29732396]
21. Hingorani S et al. Prevalence and Risk Factors for Kidney Disease and Elevated Bp in 2-Year-Old Children Born Extremely Premature. Clin J Am Soc Nephrol 17, 1129–1138 (2022). [PubMed: 35853728]
22. Vincent K et al. Recurrent Neonatal Acute Kidney Injury: Incidence, Predictors, and Outcomes in the Neonatal Intensive Care Unit. J Perinatol (2023).
23. Chevalier RL Bioenergetic Evolution Explains Prevalence of Low Nephron Number at Birth: Risk Factor for Ckd. Kidney360 1, 863–879 (2020). [PubMed: 35372951]
24. Delbridge A, Wallace S, P C & Starr MC Food Insecurity Is Associated with an Increased Risk of Neonatal Acute Kidney Injury and Abnormal Kidney Function. Proceedings of IMPRS 5 (2023).

Impact Statement

- Children with bronchopulmonary dysplasia (BPD) may have a higher likelihood of both acute and chronic kidney complications than currently recognized.
- Kidney outcomes in children with BPD is an area that remains underexplored.
- To our knowledge, this is the first study exploring the prevalence of CKD in a cohort of children with BPD.
- Our findings suggest children with BPD have high rates of kidney complications in early childhood.
- Increased attention should be placed on monitoring children with BPD for both short- and long-term kidney outcomes.

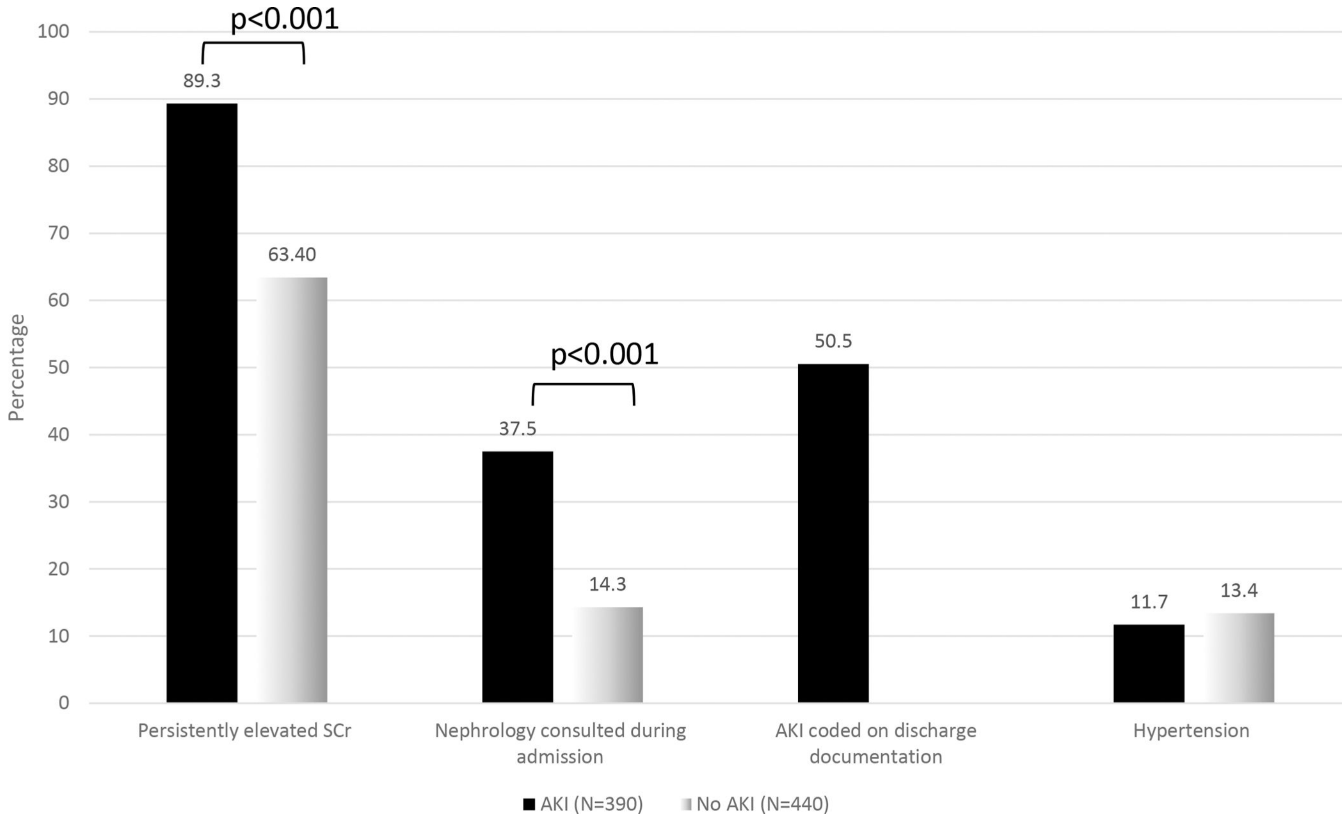

Figure 1.

Percentage of Infants with NICU Outcomes by Acute Kidney Injury Status

Table 1.

Patient demographics and birth characteristics stratified by acute kidney injury status.

Infant characteristics	Cohort *N* = 797	AKI *N* = 309	No AKI *N* = 440	*p*-value[a]
Sex (*n*, %)				0.56
Male	420 (52.7)	168 (54.4)	225 (51.1)	
Gestational Age (*n*, %)				0.23
22–24 weeks	164 (20.6)	70 (22.7)	88 (20.0)	
25–27 weeks	392 (49.2)	137 (44.3)	231 (52.5)	
28–30 weeks	214 (26.9)	94 (30.4)	105 (23.9)	
≥30 weeks	27 (3.4)	8 (2.5)	16 (3.6)	
Small for Gestational Age (*n*, %)	83 (10.4)	30 (9.7)	47 (10.7)	0.69
Mode of Delivery (*n*, %)				0.23
Vaginal	211 (26.4)	94 (30.4)	104 (23.6)	
C-Section	507 (63.6)	195 (63.1)	287 (65.2)	
Unknown	70 (8.8)	20 (6.5)	49 (11.1)	
Multiple Gestation (*n*, %)	133 (16.7)	56 (18.1)	68 (15.5)	0.86
Birth Weight, grams (median [IQR])	980 [665, 1210]	900 [726, 1158]	870 [704, 11275]	0.40
APGAR Scores (median [IQR])				
1 min	4 [1, 6]	4 [2, 6]	4 [1, 6]	0.61
5 min	6 [5, 8]	7 [5, 8]	6 [4, 8]	0.16

AKI acute kidney injury, *IQR* interquartile range.

[a] *p* value compares those with AKI to those without AKI.

Table 2.

Long-term kidney outcomes in children with bronchopulmonary dysplasia

	Frequency	**Percentage**
Outpatient Follow-Up Characteristics (*N* = 1002)[a]		
Outpatient Nephrology Care	120	12.1
Primary Reason for Nephrology Follow-Up		
Acute Kidney Injury Follow-Up	87	72.5
Hypertension	26	21.7
Other	7	5.8
Outpatient Urology Care	180	18.1
Primary Reason for Urology Follow-Up		
Hydronephrosis	142	78.9
Hematuria	10	5.6
Nephrolithiasis/Nephrocakinosis	6	3.3
Urinary Tract Infection	20	11.1
Other	2	1.1
SCr Evaluation after Discharge	525	52.4
Urinalysis Evaluation after Discharge	316	31.5
Blood Pressure Evaluation after Discharge	772	77.4
Kidney-Related Diagnoses After Discharge		
CKD after Discharge (*N* = 510)[b]	163	32.0
Age at CKD Onset (years; median [IQR])	22 [1.6–3.9]	
Proteinuria after Discharge (*N* = 328)[c]	41	12.5
Age at Proteinuria Onset (years; median [IQR])	4.7 [0.7–14.9]	
Hypertension after Discharge (*N* = 752)[d]	114	15.2
Age at Hypertension Onset (years; median [IQR])	2.0 [1.1–4.1]	

SCr serum creatinine, *CKD* chronic kidney disease, *IQR* interquartile range.

[a]Outpatient Follow-Up Data available on 1002 children remaining in the healthcare system after hospital discharge.

[b]CKD status available on 510 children with outpatient serum creatinine available.

[c]Proteinuria status available on 328 children with outpatient urinalysis available.

[d]Hypertension status available on 510 children with outpatient blood pressures available.

Table 3.

Patient demographics and birth information by chronic kidney disease status.

Infant Characteristics	CKD *n* = 163	No CKD *n* = 347	*p*-value[a]
Sex			0.26
Male (*n*, %)	69 (42.3)	151 (43.5)	
Gestational Age (*n*, %)			0.36
22–24 weeks	35 (21.5)	75 (21.6)	
25–27 weeks	67 (41.1)	166 (47.8)	
28–50 weeks	50 (30.7)	87 (25.1)	
≥30 weeks	11 (6.7)	19 (54.8)	
Small for Gestational Age (*n*, %)	24 (14.7)	27 (7.8)	0.015
Mode of Delivery (*n*, %)			0.62
Vaginal	44 (27.0)	106 (30.5)	
C-Section	92 (56.4)	192 (55.3)	
Unknown	27 (16.6)	49 (14.1)	
Multiple Birth (*n*, %)	39 (23.9)	52 (15.3)	0.014
Birth Weight, grams (median [IQR])	900 [710, 1160]	890 [685, 1125]	0.67
APGAR Scores (medan [IQR])			
1 min	5 [2, 6]	4 [2, 6]	0.60
5 min	7 [5, 8]	7 [5, 8]	0.61

CKD chronic kidney disease, *IQR* interquartile range.

[a] *p* value compares those with CKD to those without CKD.